Remarks

Claims 1-48 are currently pending in the application. Claim 17 has been canceled, and its material has been incorporated into Claim 15. Claims 1, 15, and 30 have been amended. Support for these amendments can be found throughout the instant application. In particular, support for the "at least three control zones" added per amendment can be found in Figure 1 of the instant application, which shows a combustion device having three control zones. In addition, the example in the instant application pertains to furnaces that are "tall and contain many rows of burners". *See* application, page 21, line 8. Support for analyzing samples of combusted gas from "each of" said control zones, added per amendment to claim 30, can be found in the instant application, page 10, lines 9-15, and also in Figure 1 of the instant application.

Restriction of Claims

Responsive to the requirement for election, Applicants hereby confirm the previous provisional election with traverse made by telephone on December 6, 2002, of Group I, Claims 1-45 drawn to a method/process for optimizing the efficiency of a combustion device, classified in Class 431, Subclass 2, but respectfully requests reconsideration of the requirement for restriction for the reasons given below.

Non-elected Group II, claims 46-48, classified in Class 340, Subclass 577, drawn to an apparatus suitable for analyzing combusted gas, is retained in this case pending reconsideration of the requirement for restriction.

The requirement for restriction is respectfully traversed. The requirement for restriction is based, at least in part, on grounds that the invention(s) as

set forth in the Office Action, are distinct and have required a separate status in the art as shown by the cited classifications, and that the fields of search are not the same. Both art classes referred to in the office action properly would be searched even if the Group II claims did not exist. Claims 46-48 claim an apparatus suitable for analyzing combusted gas which was combusted using the method and device of claims 1-45.

The claims of Group I, drawn to a method of optimizing the efficiency of a combustion device and a combustion device, and Group II to an apparatus suitable for analyzing combusted gas from a combustion device, are sufficiently closely related in this application to be allowable in a single application. Both groups of claims clearly relate to optimizing the efficiency of combustion devices. Furthermore, the Examiner is respectfully requested to examine MPEP 803, second paragraph, which encourages combination, such as the combination of Group I and Group II claims in this application.

The claims are so closely related in substance as to render reasonable the withdrawal of the requirement for restriction.

112 Rejection

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 1-29 under 35 USC 112, second paragraph. Claims 1 and 15 have been amended accordingly.

102 Rejection

The Examiner is respectfully asked to reconsider and withdraw the rejection of claim 1 under 35 U.S.C. 102(b) as being anticipated by Yuino, U.S. 5,630,714. Yuino discloses a furnace which "is divided into a plurality of control

zones, at least one burner is arranged in each control zone and successively subjected to combustion for a short time, and this cycle is repeated, wherein at least one temperature sensor is fitted in each control zone, a time period during which combustion is effected through each burner is adjusted depending upon a difference between a temperature detected by the temperature sensor and a preset temperature . . .and if a detected temperature of a certain zone exceeds a preset temperature, combustion is skipped for the burner in said certain zone for a given time period during which said burner is to be subjected to combustion" (*see* Yuino, column 2, lines 23-34). The instant application discloses and claims "individually measuring a combustion characteristic of the collected combusted gas from said burner assemblies in each of said control zones and individually adjusting the flow of air to each of said burner assemblies in each of said control zones in response to the value of said combustion characteristic corresponding to each of said control zones to keep the value of each of said combustion characteristics within a predetermined range" (*see* application claim 1). Yuino discloses adjusting the time period to which a burner is subjected to combustion based upon the difference between the temperatures detected by the temperature sensor and a preset temperature (*see* Yuino, column 4, lines 39-45). Therefore, combustion is either switched on or switched off for a given burner depending on the temperature. In addition, Yuino discusses that the control valve (8 in Figure 1), which controls the airflow to the burner, is interlocked with the pressure-equalizing valve (9 in Figure 1) which controls the fuel gas going to the burner (see Yuino, col. 4, lines 19-26). In other words, when the valve, which controls the air is shut off, the valve, which controls the fuel, which goes to the burner, is also shut off.

The instant application adjusts the flow of air, not the flow of fuel, to each burner assembly. In response to the temperature, Yuino adjusts the combustion. Yuino does not disclose, and Applicants have not found, individually adjusting the airflow to each burner assembly in each control zone in response to a temperature sensor or any other combustion characteristic corresponding to each control zone to keep the value of each combustion characteristic within a predetermined range.

103 Rejections

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 2 and 3 under 35 U.S.C. 103(a) as being unpatentable over Yuino in view of Sakai, 57-90522. As stated above, Yuino does not disclose, and Applicants have not found, individually adjusting the airflow to each burner assembly in each control zone in response to the value of a combustion characteristic.

Sakai discloses a boiler furnace having a plurality of burners, each burner in its own wind box. The wind boxes have branched stacks and dumpers for controlling air supply. An oxygen concentration meter, a carbon monoxide concentration meter, and a smoke dust meter are used to measure the gas from the boiler furnace. Signals of reading the concentration of oxygen, carbon monoxide, and smoke dust in the exhausting gas control the air supply to each burner (*see* Sakai, Constitution). Sakai discloses measuring oxygen and carbon monoxide concentration from the exhaust gas from the boiler furnace. Sakai does not disclose measuring oxygen and carbon monoxide concentration from each windbox. Sakai does not disclose, and Applicants have not found, at least one gas analyzer operably related to

each control zone (or wind box) for analyzing a sample of combusted gas from each control zone.

Applicants further maintain that there is no motivation to combine Sakai with Yuino. The Yuino reference discloses a process to solve the problem of controlling the temperature inside a furnace "without throttling the combustion output through each of the burners." (*See* Yuino, col. 1, lines 24-26.) Sakai discloses measuring the oxygen and carbon monoxide concentrations and controlling the air supply based on those measurements. (*See* Sakai). Since controlling the temperature is the primary purpose of Yuino, measuring the oxygen or carbon monoxide concentrations, as in Sakai, would alter this purpose. According to the MPEP, "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." *See* MPEP, Eighth Edition, p. 2100-125. Therefore, there is no motivation to combine Sakai with Yuino.

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 7 and 11 under 35 U.S.C. 103(a) as being unpatentable over Yuino in view of Neumann, DE 42 06 377 A1. Once again, as stated above, Yuino does not disclose, and Applicants have not found, individually adjusting the airflow to each burner assembly in each control zone in response to the value of a combustion characteristic.

Neumann discloses probes for oxygen, carbon monoxide, and carbon dioxide contents in the exhaust gas path (*see* Neumann). Neumann does not disclose

these probes as being in separate, individual control zones. Neumann does not disclose, and Applicants have not found, means for adjusting the air flow to each burner assembly in each control zone in response to the value of a combustion characteristic measured in the collective combusted gas streams corresponding to each control zone.

Additionally, since Neumann measures oxygen, carbon monoxide, and carbon dioxide content in order to control the airflow, and Yuino, as stated above, has a primary purpose of controlling temperature, there is no motivation to combine Neumann with Yuino.

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 15-18 under 35 U.S.C. 103(a) as being unpatentable over Yuino in view of Lewis, U.S. 4,474,121. Claim 17 has been canceled. Once again, as stated above, Yuino does not disclose, and Applicants have not found, individually adjusting the air flow to each burner assembly in each control zone in response to the value of a combustion characteristic corresponding to each control zone to keep the value of each combustion characteristic within a predetermined range.

Lewis discloses a two-stage combustion furnace (*see* Lewis, col. 3, lines 1-3), where a primary combustion of a combustible material with sub-stochiometric quantities of oxygen is performed in the first stage. Gases from the first stage pass to the second stage combustion chamber and are combusted with an excess of air to produce a flue gas (*see* Lewis, col. 3, lines 63-68). The rate of airflow to the second stage is generally controlled by a valve or a damper actuated by the temperature controller. According to Lewis, the signal from oxygen analyzer 18 is

directed to controller 16. Controller 16 actuates valve or damper 17 to reduce the rate of primary airflow 7. *See* Lewis, col. 4, lines 16-20. According to Figure 2 in Lewis, oxygen analyzer 18 only sends signals to controller 16. Controller 16 can only activate valve 17 to control the primary airflow. Controller 16 is not in any way connected to valve 10, which regulates the secondary airflow.

Lewis does not disclose, and Applicants have not found, a combustion device comprising at least three control zones wherein the air flow to each burner in each control zone is adjusted individually in response to the value of a combustion characteristic corresponding to each control zone, wherein the combustion characteristic is selected from the group consisting of oxygen concentration, carbon monoxide concentration, carbon dioxide concentration, and combinations thereof, to keep the value of each combustion characteristic within a predetermined range. Lewis only discloses a combustion device having one control zone and also, the secondary airflow in Lewis is adjusted in response to temperature measurements. In addition, there is no motivation to combine Lewis with Yuino. Lewis states, "The principle object of the present invention is to enhance control of a two-stage furnace such that the first stage is always operating with excess air, regardless of variations in feed rates and thermal values of the combustible manner." *See* Lewis, col. 2, lines 47-52. Yuino discloses adjusting the combustion of each burner in response to a temperature measurement. *See* Yuino, col. 2, lines 9-20. Since Lewis adjusts the airflow, and Yuino adjusts the combustion, adjusting the airflow would alter the primary purpose of Yuino; therefore, these references are not meant to be combined.

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 22 and 26 under 35 U.S.C. 103(a) as being unpatentable over Yuino in view of Lewis and Neumann. Once again, Yuino does not disclose, and Applicants have not found, individually adjusting the air flow to each burner assembly in each control zone in response to the value of a combustion characteristic corresponding to each control zone to keep the value of each combustion characteristic within a predetermined range. In addition, as stated above, Lewis does not disclose, and Applicants have not found, a combustion device comprising at least three control zones with each control zone comprising at least one burner assembly. Neumann does not disclose, and Applicants have not found, means for adjusting the airflow to each burner assembly in each control zone in response to a value of a combustion characteristic measured in the collective combusted gas streams corresponding to each control zone or a gas analyzer operably related to each control zone for receiving and analyzing samples of combusted gas from each control zone.

The Examiner is respectfully asked to reconsider and withdraw the rejection of claims 30-33, 35 and 36 under 35 U.S.C. 103(a) as being unpatentable over Sakai in view of Lewis. Once again, Lewis does not disclose, and Applicants have not found, a combustion device comprising at least three control zones with each control zone comprising at least one burner assembly. Sakai discloses a boiler furnace having a plurality of burners, each burner in its own wind box. The wind boxes have branched stacks and dumpers for controlling air supply. An oxygen concentration meter, a carbon monoxide concentration meter, and a smoke dust meter are used to measure the gas from the boiler furnace. Signals of reading the

concentration of oxygen, carbon monoxide, and smoke dust in the exhausting gas control the air supply to each burner (*see* Sakai, Constitution). Sakai discloses measuring oxygen and carbon monoxide concentration from the exhaust gas from the boiler furnace. Claim 30, as amended, discloses "at least one gas analyzer operably related to each of said control zones for receiving and analyzing samples of combusted gas from each of said control zones."

In the Background Section, the instant application states that "an example of a combustion device is a hydrocarbon cracking furnace which transfers heat in a controlled manner to a hydrocarbon, such as ethane, propane or butane, for conversion to olefins. The typical air flow burner adjustment method for such furnaces is based on furnace draft measurements, flame appearance and volume percent oxygen in the stack outlet gas. This procedure can lead to inefficient furnace operation wherein the oxygen level in the stack outlet gas is low, but the heat used for high economic value processes is also low. This can occur if significant fuel combustion and heat transfer occurs in the secondary heat recovery section, higher in the furnace (nearer the stack) and not in the lower section of the furnace where the highest economic value can be realized from the heat transferred to the charge materials." *See* application, page 2, lines 6-16. Reference is also made to the Example of the instant application wherein the inventive adjustment method results in a more efficient operation than the standard adjustment (based upon measurements from the furnace draft). Measuring combustion characteristics for each control zone provides for a more even airflow adjustment throughout the entire furnace and therefore constitutes a patentable improvement over Sakai.

The Examiner is respectfully asked to reconsider and withdraw the rejection of claim 34 under 35 U.S.C. 103(a) as being unpatentable over Sakai in view of Lewis and Neumann. Once again, Sakai does not disclose, and Applicants have not found, at least one gas analyzer operably related to each control zone for receiving and analyzing samples of combusted gas from each control zone, and means for adjusting the flow of primary and the flow of secondary air to each burner assembly in each control zone in response to the value of a combustion characteristic measured in the collective combusted gas streams corresponding to each control zone. Once again, as stated above, Lewis does not disclose, and Applicants have not found, a combustion device comprising at least three control zones with each control zone comprising at least one burner assembly. Once again, as stated above, Neumann does not disclose, and Applicants have not found, means for adjusting the airflow to each burner assembly in each control zone in response to a value of a combustion characteristic measured in the collective combusted gas streams corresponding to each control zone or a gas analyzer operably related to each control zone for receiving and analyzing samples of combusted gas from each control zone.

Applicants gratefully acknowledge the indication of Allowability for claims 4-6, 8-10, 12-14, 19-21, 23-25, 27-29, and 37-45.

In view of the foregoing remarks, reconsideration and allowance of claims 1-16 and 18-48 are respectfully requested.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231, on

25 April 2003
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